# Cathode ray digital information display systems as a man-made interface

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What are the desirable or essential elements of any display system if it is to have practical value in a human operator / computer conversation?

*Clarity of character*

Character recognition is a complex activity, as various attempts to automate it have shown in the past few years. When a human being is involved in the recognition loop, there are two requirements which become more important than the many others: outline clarity, so that the operator can relate it without effort to his remembered image of the character; and total lack of ambiguity. Human operators can restore plain language texts to error-free conditions by correcting errors from information derived from their context; but no one will deny that this is an inefficient operation, liable to error.

*Brightness and colour*

Any presentation of plain language intended to be read should be capable of operating in normal office lighting conditions with sufficient contrast between character and background to make reading easy. A character brightness level of 40 to 50 foot Lamberts has been found to be acceptable. As to colour, it is popularly accepted, and medical evidence tends to support this, that green is the least trying colour for human beings to gaze at for long periods.

*Freedom from fatigue*

The human eye is remarkably responsive to movement, which tends to assert priority for attention. This is, of course, a byproduct of defence mechanisms which were, and still are, necessary for survival. This sensitivity operates against efficiency when the attractions become distractions. Reading a shimmering script is a great trial, as anyone who has tried to read a book in a car will testify. Character stability is very important if long periods of operations are to be relieved of fatigue and consequent errors.

*Freedom from flicker*

Light of flickering intensity also attracts the attention and promotes fatigue. Cinema standards of 25 new frames per second are just acceptable at relatively low brightness, television has adopted 50 frames, by the trick of interlacing, but even this can be noticeable. Anyone who has looked at a fluorescent light tube from the corner of his eye will recognise 50 cycles when he sees it. There are two common solutions to this problem. The first, which in effect attempts to sustain the light output for an appreciable time between one paint and the next, mitigates the flicker appreciably, but cannot quite reduce it to zero. The second is to use a higher refresh rate than 50 cycles per second.

In the Dids 400 system character generation is by monoscope cathode ray tube. A systematic search of a prepared character is made and the information derived used to paint an exact replica on another cathode ray tube screen. The prepared character may have any form which can be created; symbols may be used; or alpha-numeric characters in any font, with fine details like serifs clearly exposed. The definition is equivalent to a television system having 1,000 lines (more than twice our currently accepted 405 system) and considerably better than the high definition 625 system.

The CRT used for display has a light output of 50 foot Lamberts from the face, and is green in colour. Tubes are available which give an orange colour, or white on black, or black on white, for those who remain unswayed by medical opinion. Freedom from jitter is ensured by deriving all timing from a self-contained crystal source. The total uncertainty of timing is such that the jitter in any character is below the level of perception. The refresh rate is 67 cycles per second, derived from the crystal.

*Local character generation*

It is desirable to place the character generator in any display system close to the display, since at this point information is transferred at very high rates, demanding wide band transmission and low losses. In the Dids 400 the monoscope generator is located within the unit, and contains 64 prewritten characters, each readily accessible.

Information about which character is to be written at which point on this display has to be stored, so that the same character can be written again 15 mS later. This storage should also be local for the same reasons as the generator above. In the Dids 400 it is contained within the unit, and can store all the information needed to refresh 520 characters on the display screen. Other units have double this capacity—1,040 characters.

*Flexible editing facilities*

Entry of any character from a keyboard is essential to the creation of a text. Entry is effected at a point on the display indicated by a special character known as a curser. Any character in the font can be written at this point. Any character entered will replace a character which is already there, so that corrections are simple. Curser movements enable any character in the display to be selected rapidly from any other point on the screen. Lines are written systematically, each containing between 40 and 80 characters (design option) and the number of lines is limited only by the storage capacity.

Any of the visible characters on the keyboard may be entered,

*Cossor Raytheon DIDS 400 Series*

either by direct key depression, or by using the shift key (typewriter shift action) to enter ' upper case ' characters. A version of the Dids 400, having a font of 96 characters including full upper and lower case alphabet symbols, is in operation.

In order to make transmission of information possible from the input keyboard to the computer, the store always holds the relevant information in a compatible form for direct recognition by the computer. This automatic byproduct of the system eliminates any need for code conversion before transmission. Any code may be specified, but ASC11-2 is a favourite for obvious reasons, when telegraph line data transmission is involved. Functionally, a transmit key enables transmission to take place from the present position of the curser to the first end of message (EOM) character recognised. This information can thus be despatched to a computer or some other recipient—another display for instance, or a hard copy unit. Other function keys could designate the choice of a particular program from the computer's normal range, or request hard copy print out.

*High-speed computer conversations*

The high refresh rate of the display makes available an entire frame full of information for transmission to a computer in 15 mS. The display will also accept information at this speed, which makes it possible to service more than 64 displays with fresh information every second. This high transfer rate makes it possible to timeshare the computer facility between many displays. The fact that information need be sent only once (because of the local memory) makes it possible to take full advantage from this. Displays which are local to a computer can timeshare its facilities without congestion—the worst case delay for transfer is one second, which is a most unlikely contingency. When the displays are not local, some transmission medium is interposed between the display and the computer. This is most likely to be a telephone line—which limits the transmission bandwidth to that acceptable on ordinary speech lines. Control units are available which will multiplex many input/output units to a single data transmission line. Under these circumstances the data rate is restricted to 120 characters per second (1,200 bauds) and a full frame will take some four or five seconds to transmit. When 2,400 baud and 4,800 baud lines become available these delays will be halved and halved again respectively. It is of course essential to have some form of transmission error detection system. Parity bits are generated for each character being transmitted, and each character is checked for its parity correctness when received.

**Applications to typesetting**

The first and most obvious use of the Dids 400 keyboard display is in the preparation of the initial copy. Since there is automatic transfer of character write-in from the end of the one line to the beginning of another, scripts may be entered continuously without dead spaces or lost characters. This may continue until the frame is full.

The entire copy containing broken words may then be sent to a computer programmed to justify and edit the material into acceptable format. When this is completed the entire frame of information may be sent back to the point of origin for checking and editing by the operator. This procedure may be repeated indefinitely until the operator is satisfied that the copy is correct, and correctly justified etc. At this point the copy, in its correct format, may be sent for typesetting.

The second use concerns the preparation of copy employing multiple fonts. A series of function keys or a preliminary ' setting-up ' programme may be used to designate certain fonts (and sizes) which may be called up during script preparation. How this will be done in practice depends on experiments, but one suggestion is to designate non-printing symbols from the range to designate start and finish of special typefaces. These symbols would appear on the display—but not, of course, in the finished typeset.

Thirdly, there is the possibility of presenting the finished typeset in its true typeface on a special display which can access any of the cases (and sizes) of character normally used and display it in its correct place in the format. This would enable layout to be checked.

Finally, if the previous possibility is ambitious let us not be afraid of the possibility of setting pages from such equipment by direct means, eg photography. Magazine pages could be compiled in this way, and transferred as a page to the print matrix.